OBSERVATIONS

PHYSIOLOGICAL AND CHIRURGICAL

ON

COMPOUND FRACTURES.

CONTAINING,

An ANSWER to the following Queſtion:

"What are the beſt methods of treating Compound
"Fractures, according to the degree of injury ſuſtained by
"the limb?"

By *WALTER WELDON, Surgeon.*

"Similis rurſus ex magna parte caſus curationeſque ſunt humeris et femoribus. Comminuuntur etiam quædam humeris, brachiis, femoribus, cruribus, digitis."

SOUTHAMPTON,
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TO

DR. WILLIAM SAUNDERS,

FELLOW OF THE COLLEGE OF PHYSICIANS,
OF THE ROYAL SOCIETIES OF LONDON
AND EDINBURGH,
AND SENIOR PHYSICIAN TO GUY'S HOSPITAL.

DEAR SIR,

I Embrace with pleaſure this opportunity of acknowledging my obligations for the advantages I obtained from you during the proſecution of my ſtudies, and of expreſſing the high reſpect I entertain for your private, as well as for your profeſſional character.

I have the honor to be,
DEAR SIR,
Your moſt obedient humble ſervant,
W. WELDON.

ADVERTISEMENT.

The obſervations in the following pages were put into the form of an eſſay in anſwer to the annual prize-queſtion of the Lyceum Medicum Londinenſe for the year 1792. Had they not met with the attention of that ſociety, they would not now be ſent before the public tribunal.

This eſſay is not to be conſidered as an attempt even at a complete treatiſe: it is only a collection of obſervations which have been made as occaſion offered; and which were intended originally merely for my private uſe. The ſubject of it, from its frequent occurrence, and the confinement and danger that often attends it, is of great importance to mankind. And although it has attracted much of the attention of moſt ſurgeons of eminence, yet I believe it will be found ſuſceptible of very great improvement. How far this little work may contribute to that end, my profeſſional reader will judge.

The producing of union by adheſive inflammation, it is well known, is not new. But of this I am certain, that very little attention has generally been paid to it in proportion to the chance of ſucceſs and the probable advantages to be derived from it. And where I have ſeen it attempted, the manner in which the limb was dreſſed was ſuch, that any perſon acquainted with the principle by which the living actions produce it, muſt know that it could not take place, unleſs by mere accident.

Compound fractures have frequently been treated on. The principles by which union is produced are now very well, though not very generally underſtood. Conſequently many of the obſervations in the following pages are not new. But I have ſtated nothing of which I have not received conviction, either from a conſideration of the laws of the human machine, occaſional experience, or an attentive obſervation of facts. I am too well acquainted with the weakneſs of the human mind even in the greateſt of us, to hazard any opinion merely upon the authority of another.

In a certain publication, in which my eſſay on the different modes of puncturing the bladder, &c. is noticed, it is aſſerted that the obſervations and arguments in that publication are ſtrikingly ſimilar to thoſe which had before fallen from Mr. Cline, of St. Thomas's hoſpital, in his lectures on the ſame ſubject. I believe the writer never heard that gentleman. It is very well known to all Mr. **CLINE**'s pupils, that he treated of this operation, and of the diſeaſes of the bladder, very curſorily, and indeed the extenſive plan of his lectures rendered it neceſſary; that he took no notice of the diſadvantages, or of the advantages ariſing from the different diſeaſed ſtates of the parts concerned in the different modes of operating; that he condemned the operation per anum as always improper, and the operation ſupra pubes as very objectionable; and that he recommended the operation in perinæo as univerſally the beſt. Had I been ſenſible of deriving from this gentleman, or from any other perſon, any matter on this ſubject with which the public were unacquainted, I, in juſtice to my own character, ſhould have mentioned it.

SOUTHAMPTON,
MAY 19, 1794.

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OBSERVATIONS, &c.

CHAP. I.

INTRODUCTION.

"WHAT are the beſt methods of "treating compound fractures, according to the degree of injury ſuſtained "by the limb?"

By a compound fracture (I ſuppoſe) is meant, the diviſion of a bone in two or more pieces, connected with a wound in ſome of the ſurrounding parts.

As the latter part of the above queſtion ſtates "according to the degree of injury ſuſtained by the limb," it appears that the queſtion is confined to compound fractures of the bones of the extremities: to theſe, therefore, I ſhall confine my obſervations in the following eſſay.

When, from external violence, a bone is fractured, and the ſurrounding parts lacerated and torn, the objects of ſurgery are, to prevent the ſubſequent inflammation becoming ſo great as to deſtroy life, and (if poſſible) to reſtore the limb to its healthy ſtate and function.

To effect this, we (to uſe a common phraſe) muſt aſſiſt nature. In other words, there belongs to animal bodies an internal power of action. The effects which this power produces, are very much influenced by the operation of external agents, applied either locally or to the whole ſyſtem. Had a limb that is fractured no internal power of action, it muſt ever remain as the accident leaves it; the aſſiſtance of ſurgery would be vain. But a change is very ſoon obſerved to commence: an inflammation comes on: and it is in the management of this inflammation that the buſineſs of the ſurgeon conſiſts.

This power of action in animal bodies is called, ſimple life.

Till of late years, very little notice appears to have been taken of it by the generality of ſurgeons, or phyſicians, or even of phyſiologiſts; and thoſe few who have noticed it, ſeem to have entertained very vague and confuſed ideas concerning it. It was brought into notice, principally, by the labors of Mr. John Hunter; and is now pretty generally taught in the ſchools of London. Daily experience, however, convinces me, that neither this power of action, nor its effects, are by any means generally known; and that very erroneous ideas are entertained, by many, concerning it.

In treating compound fractures upon a rational plan, a knowledge of the properties depending on the life of the part, is as neceſſary as the knowledge of thoſe depending on the matter, if not more ſo. Therefore, I beg leave to offer ſome explanation of theſe properties, ſo far as their agency appears concerned in the ſubject before us, or as the conſideration of them appear neceſſary to render the ſenſe in which I uſe the term 'life' preciſely underſtood.

This work being intended rather for the uſe of the younger part of the profeſſion, and of thoſe practitioners whoſe opportunities for obſervation are but few, I hope will be a ſufficient apology to ſuch of my readers as may think any explanation on this ſubject unneceſſary.

An animal body, whilſt alive, poſſeſſes a power of reſiſting thoſe changes which chemical attraction has a tendency to produce in it. It has a power, alſo, of producing within itſelf ſuch changes as are neceſſary for its growth, its nouriſhment, its various ſecretions, its reſtoration from mechanical injury, and for a variety of other functions.

Upon what this power depends; whether upon any unknown peculiarity in the ſtructure of animal matter; or upon the agency of ſome unknown principle connected with this matter; or whether we have any idea of its cauſe or not; it is unneceſſary, in this place, to inſiſt. That ſuch a power does exiſt, (I believe) no one who credits the teſtimony of his ſenſes will deny: that it may, with great eaſe, be deſtroyed; and that, when deſtroyed, it cannot be reſtored by human art; is as evident. This power I call life.

It does not appear to conſiſt in organization: it is not, at leaſt, that organization which is ſubject to our ſenſes. It exiſts not only with a great diverſity of organization, but, alſo, without any that is apparent: as in the blood, for inſtance; in the albumen, and yolk of eggs: and life may be removed by means which cannot, immediately, affect organization.

Neither does it appear to conſiſt in any chemical property of matter; for living matter is not ſubject to the laws of chemical attraction: on the contrary, although placed in circumſtances the moſt favorable for their operation, (being expoſed to the proper temperature and moiſture, and the application of an external agent,) it is conſtantly reſiſting them; but the moment life is removed, fermentation (which is a chemical proceſs) takes place, and putrefaction is produced.

Nor is red blood; nor are brain and nerves, and the ſenſation conſequent thereon; nor is intelection; neceſſary to ſimple life. Animals are found, in which none of theſe can be traced: indeed, it extends to the whole vegetable part of the creation, in which their preſence is not ſuſpected.

It appears, at the ſame time, that living, animal matter (which is not vaſcular) is eaſily deprived of its life; and is capable of performing very few actions :---I think it is incapable of performing any. I will attempt to illuſtrate my meaning with an example.

A new-laid egg is capable of reſiſting the chemical action of the ſurrounding air. On the application of a certain ſtimulus, it is capable, alſo, of undergoing ſuch a change that a chick is produced. Mr. Hunter ſays, that it reſiſts the action of cold, to a certain degree: but the experiments of Mr. Haighton (lecturer on phyſiology at Guy's hoſpital) contradict this aſſertion. Indeed, conſidering the manner in which animal matter reſiſts the action of external cold, the power of an egg, in this reſpect, muſt be very weak, and alſo confined to a ſmall part of it.

Either of the above properties prove that the egg poſſeſſes life.---There is the ſtrongeſt preſumption that they depend on one and the ſame cauſe: remove the one, and the other is removed. On examining the component parts of the egg, it is found that the yolk and albumen are not vaſcular; nor are they of a conſiſtence to admit of what is anatomically called organization. It is found, alſo, that, during the proceſs of incubation, they produce no change within themſelves; and that their life has no other effect than that of preſerving them from putrefaction, whilſt they ſerve the purpoſe of affording proper matter for the formation, and nouriſhment of the chick.

The embryo, in its earlieſt ſtate, is ſo extremely ſmall, and ſo tender in its ſtructure, as to elude our examination: therefore, it cannot be aſſerted poſitively that it is vaſcular; although there can be little doubt of it being ſo, and of its having derived this vaſcularity from the mother.

If theſe propoſitions are juſt, it appears, that life being preſent in unorganized animal matter, gives it a power of ſelf-preſervation, but not a power of action; and that organization is neceſſary to action. It appears alſo, that animal matter may poſſeſs life and organization, and yet be free from action; that a ſtimulus is neceſſary to produce action, and to continue it when produced: this is remarkable in eggs, prior to incubation; and in torpid animals, whoſe actions are in great meaſure dormant in ſevere cold.

Although ſimple life is, in ſome inſtances, found to exiſt in a maſs of apparently unorganized animal matter, it is more generally found connected with matter completely organized; and this organization cannot be deſtroyed, without deſtroying

life.

life. Animals having red blood, cannot be deprived of more than a certain proportion of it, without being deprived of life alſo. In the more perfect animals there are a variety of functions intimately connected with life, and abſolutely neceſſary for its ſupport, which depend, in great meaſure, on the agencies of chemical attraction, and the mechanical properties of matter.

In what manner any peculiar action produces its effects, or in what it differs from another peculiar action, human faculties do not appear ſufficiently extenſive to aſcertain: we judge that actions differ, becauſe we find that their effects differ. As the material and living principles ſeem to be the ſame in all animal bodies, it is probable that a difference in the actions depends on a difference in the organization of parts: but this is very clear, even to the moſt ſuperficial obſerver, that all thoſe actions depending on life are perfectly different from any chemical or mechanical actions, and cannot be imitated by them.

We find, not only parts differently organized performing different functions, but even the ſame part performing different functions: thus, the liver produces bile; the ſalivary glands, ſaliva; &c. At the ſame time, an action goes on in theſe parts, producing the matter whereof they are compoſed; (for they are continually undergoing changes:) their matter is gradually removed by the abſorbents, and freſh matter depoſited in its place.

When the power of action exiſts, actions are capable not only of being produced by the application of a ſtimulus, but when produced they are capable of being increaſed, and even changed, by applying an additional ſtimulus: and if the additional ſtimulus be not too violent, upon removing it, the increaſed or altered action will be removed. This law is a wiſe proviſion of our Creator: upon it depends all the powers of reſtoration in animals. In a limb, for inſtance, a variety of actions are going on for the preſervation of it, and to enable it to perform its various functions. If by any violence a ſolution of continuity is produced, either in the ſoft parts or in the bone, this proves a ſtimulus; the actions are increaſed, and probably changed, at leaſt new effects are produced: a quantity of coagulable lymph is thrown out, which, if the parts are retained in contact, forms a connecting medium between them, becomes vaſcular, and gradually takes on the ſtructure of the adjacent part. The limb being thus reſtored to its former ſtate, the ſtimulus ceaſes, and with it the increaſed or altered action. Or, if reſtoration is not thus produced, the ſtimulus continuing increaſes

creaſes the inflamed action further, or a ſtill different action ariſes; pus is formed; and new fleſh or bone appears, in the form of granulations: theſe gradually riſing fill up the cavity, and unite the parts: then the ſtimulus ceaſes, and the actions return to their former ſtate. But the ſtimulus may be too great. The actions may be increaſed to ſo violent a degree as to deſtroy the organization: then all action ceaſes, and the part dies.

Thus we ſee that the ſame part is ſuſceptible of different actions, and degrees of action, in conſequence of the application of different degrees of ſtimuli; that ſome of theſe actions tend to its reſtoration, others to its deſtruction. But mechanical, and even chemical ſtimulants, may be ſo violent as inſtantly to kill a part, before any change in the living actions can take place.

Beſides the kind of actions noticed above, and which perhaps may be termed ſimple actions, an animal body, the human more particularly, is ſubject to a very great variety of complicated actions, giving riſe to that multitude of diſeaſes to which we are liable. As we know ſo little of the healthy actions of the animal economy, excepting by their effects, it is by no means ſurpriſing that we know little or nothing of its diſeaſes, excepting by their effects alſo.

Man is the moſt perfect, by conſequence the moſt complicated part of the animal creation. In him ſimple life is intimately connected with matter under a great diverſity of organization, giving riſe to a ſtill greater diverſity of actions. He has a large quantity of red blood. In his ſyſtem a variety of functions are performed, wherein the agency of chemiſtry, and of mechaniſm are neceſſary. The proportion of his brain and nerves is very conſiderable; his ſenſations are acute; the power of ſympathy over his ſyſtem is very great; the influence of habit no leſs ſo. In addition to theſe, he has an imagination that is generally lively; a ſtrong recollection; and the faculty of reaſon.

Theſe are all intimately connected together; no one can be affected, in any conſiderable degree, without more or leſs affecting the reſt, and frequently endangering the deſtruction of the machine.

CHAP. II.

SOME OBSERVATIONS ON THE ECONOMY OF THE BONES.

HAVING in the laſt chapter explained what I mean by the term 'ſimple life,' and hazarded a few obſervations on the animal economy in general, I proceed to conſider ſome part of the economy of the bones. I ſhall confine myſelf to thoſe obſervations which occur to me as connected with the ſubject before us.

The bones I conſider as living, organized parts. Like other living parts, they are ſuſceptible of a variety of actions, both healthy and diſeaſed.

This doctrine will to many probably appear new, as formerly the economy of the bones was very little underſtood. It was ſuppoſed, that the bones were ſuſceptible of no change, or diſeaſe, but that of becoming carious ; every diſeaſe occurring in them was ſuppoſed to be a caries. It is principally to the labors and ingenuity of Mr. John Hunter, that the world is indebted for an explanation of the economy, and of the diſeaſes of bones ; by conſequence for that improvement in their ſurgical treatment, which ſuch a knowledge naturally points out.

The ſtructure and organization of bones differ, in ſeveral reſpects, from thoſe of other parts. It is obſerved above, that a difference in organization is the cauſe of a difference in action. Accordingly, the actions, both healthy and diſeaſed, which take place in bones, differ in ſeveral reſpects from thoſe which take place in the other parts of the body.

To enumerate all the actions which take place in bones, is to enumerate moſt of the general actions, healthy and diſeaſed, which occur in other parts of the human body; and to point out thoſe peculiarities which are the conſequence of their peculiarity in ſtructure. Indeed I think it would be unneceſſary, in this place, to enumerate any, were it not that many ſurgeons ſtill entertain very erroneous notions, not only of the diſeaſed actions to which bones are liable, but of thoſe actions alſo which are neceſſary to reſtore them to an healthy ſtate.

The living powers of the different parts of the human body are, generally ſpeaking, in proportion to their vaſcularity; and if we except thoſe which are newly formed, as cicatrices, callus, &c. parts poſſeſſing leſs vaſcularity are generally leſs ſuſceptible of diſeaſes; but when diſeaſed are more difficult to manage.

The bones are leſs vaſcular than moſt other parts; their living powers alſo are much weaker; the quantity of earth contained in them renders them much firmer, and more reſiſting in their ſtructure. In conſequence of theſe differences, it is very generally found that

1. The bones are leſs ſuſceptible of diſeaſed actions than the ſofter parts; and when diſeaſed, require more care, and attention in the treatment.

2. All the actions, healthy and diſeaſed, taking place in bones, are ſlower in their progreſs than ſimilar actions taking place in ſoft parts.

3. The diſeaſed actions of bones are more liable to produce death in them, than thoſe of ſoft parts.

But it is obſervable, that the bones differ conſiderably in ſtructure; ſome being very cellular, and vaſcular, containing a comparatively ſmall proportion of earth; others being very cloſe in their texture, containing but few veſſels, and a comparatively large proportion of earth.

The cellular part of bones is more ſuſceptible of conſtitutional diſeaſes. Theſe diſeaſes make a more rapid progreſs in it than in the more compact part of bones, and are leſs liable to produce death.

Bones, like the ſoft parts, are ſubject to inflammation, and to its conſequent ſymptoms—pain, increaſed vaſcularity, and tumor: but the progreſs of inflammation in them is ſlow. Its termination may be by reſolution, in ſuppuration, or by mortification taking place.

Reſolution, or the diminution of inflammation before it produces ſuppuration, ulceration, or death, takes place very ſlowly in bones; and they are generally left larger, heavier, and more compact, in conſequence of an increaſed depoſition of earth taking place during the inflammation, which it requires a conſiderable length of time to remove.

Excepting in ſcrophulous conſtitutions, and under certain ſpecific diſeaſes, ſuppuration rarely takes place in bones from internal cauſes: however, they are ſuſceptible of ſuppuration; and in caſes of local injury, where granulations are neceſſary for the reſtoration of the part, it always comes on; but its progreſs is ſlow.

On account of the weak living powers and the proportionally ſmall vaſcularity of bones, mortification is more liable to take place in them than in ſoft parts. If a large blood-veſſel going to a bone is divided, the anaſtamoſing branches are ſeldom capable of continuing the circulation complete; and as far as that ceaſes the bone dies, and then exfoliates.

When a bone is fractured without a wound in the ſoft parts, as in what are termed ſimple fractures, adheſive inflammation takes place, after the ſame manner that it does in the ſoft parts, but the proceſs is more ſlow. Firſt a ſmall quantity of blood is thrown out from the torn veſſels, forming a tumor which fills up the ſpace between the broken extremities of the bone: this blood retains its life: the red particles, and the ſerum are abſorbed, and the coagulable lymph is left alone. In the mean time, the oſſific matter is abſorbed from the broken extremities of the bone, by which means the irregularities are removed, and they are rendered ſoft and flexible; their living powers are increaſed; and they appear more vaſcular, the veſſels becoming enlarged, and probably branching off new ones. Theſe veſſels gradually elongate, and extend into the coagulable lymph until they meet, when they anaſtamoſe with each other: oſſific matter is then depoſited along their outſides, extending from the bones to the centre; thus forming a ſubſtance which is called callus.

This callus is generally of larger diameter, and by conſequence mechanically ſtronger than the adjacent bone. When the actions of life are in their healthy ſtate, and not interrupted, the quantity of callus formed is in proportion to the diſtance which the extremities of the bone are from each other: if they are far aſunder, the quantity of callus is large, forming ſometimes a very conſiderable tumor; if they are in contact, and well placed, the quantity of callus is very ſmall, and the tumor ſcarcely perceptible.

At firſt the callus is more vaſcular than the original bone, but the depoſit of earth goes on; the veſſels, after a certain time, are leſſened in their diameters, ſome of them perhaps obliterated; and it becomes leſs ſo:

its living powers alſo are leſs. After a ſtill longer time, it approaches in ſtructure to the neighboring bone, becoming again ſomewhat more vaſcular. I have ſeen ſome bones that were fractured many years before death, in which I could diſtinguiſh little or no difference, either in ſtructure or in vaſcularity, between the original bone and that formed after the fracture.

This is the mode of union which generally takes place in ſimple fractures, and ſometimes in compound fractures alſo: it is by much the ſhorteſt, the ſafeſt, and the moſt deſirable. If the limb is properly attended to, the pain, the trouble, and the time of confinement, are proportionally ſhort, and it is attended with no danger to the ſyſtem.

When this mode of union does not take place; as in moſt caſes of compound fractures; and now and then in conſequence of a very a very great injury, or of improper treatment, in ſimple fractures alſo; a very different proceſs produces the re-union of the parts.

The coagulable lymph, which in the former caſe forms the medium of union, loſes its life, or eſcapes. The inflammation increaſes to a greater degree, both in the bone and ſoft parts: ſometimes it becomes ſo violent as to threaten deſtruction, not to the limb only, but to life. In the more favorable caſes, after three or four days, ſuppuration appears extending over the whole of the wounded ſurface; generally attended with no ſmall degree of pain, and with conſiderable fever. As the formation of pus becomes perfect, and the quantity of it increaſes, the inflammation abates; and the conſtitutional ſymptoms abate with it. Frequently for ſome days the pus is intermixed with what are called ſloughs. Theſe are generally ſuppoſed to be ſome of the organized parts that were killed by the mechanical violence which produced the fracture; but in the caſes I now ſpeak of, they are nothing elſe than portions of coagulable lymph that were thrown out during the firſt ſtage of the inflammation. The cavity which after a time is obſerved in the wound, is formed partly by the retraction of the ſurrounding living parts, and partly by the ulceration, or abſorption of them.

In conſequence of the deſtruction of ſome of the ſmall arteries of the bone, a ſmall portion of each of its broken extremities generally loſes its life. Thus becoming an extraneous body, it acts as a ſtimulus to the abſorbents of the living bone, with which it is in contact. Theſe gradually remove as much of the living bone as forms the line of union, by which means the dead portion is ſeperated. This proceſs is called exfoliation; and neceſſarily occupies ſome time. Whilſt it is going on, a part of the bony matter is abſorbed from the broken extremities, as in the caſe of ſimple fractures: then granulations form, and gradually extending from each extremity meet and unite, the veſſels inoſculating one with another.

Theſe granulations are very ſimilar in appearance to thoſe formed by the ſoft parts; but they are ſmaller, more regular, ſlower in their progreſs, and rather paler than thoſe of ſoft parts generally are: when examined they are found to be bony, excepting juſt on their ſurface. If in this ſtate they are macerated, the eminences on the dried bone correſpond exactly to thoſe of the granulations when freſh. So that it ſeems the ſoft part of the bone is formed firſt; but the bony depoſit very ſoon ſucceeds it, in regular progreſſion.

The two portions of bone being thus united, the formation of bony granulations ceaſes; the part becomes leſs vaſcular; and the bony depoſit continuing, it becomes alſo mechanically ſtronger. In the mean time, the granulations formed by the ſoft parts extend over thoſe formed by the bone. The cicatrix then extending over them, the wound is healed.

The bony ſubſtance formed by granulations, like ſoft parts formed in a ſimilar manner, poſſeſſes very weak living powers, and is very ſuſceptible of diſeaſed actions, as ulceration, &c.

I have now attempted a deſcription of the method by which the living actions of the parts produce re-union, after compound fractures (ſtrictly ſo called). Even in the moſt favorable caſes it is very tedious, from the ſlowneſs of the proceſs which unites the bones. I have repreſented it here, as occurring in a favorable ſubject; and have ſtripped it of all thoſe untoward circumſtances, ſome of which are almoſt conſtantly met with in the courſe of the treatment.

CHAP. III.

OF COMPOUND FRACTURES, AND THE TREATMENT OF THEM.

COMPOUND fractures happen to perſons of different ages and conſtitutions; in health or in ſickneſs: they occur in different parts of the extremities; and are produced by different degrees of violence. Two fractures therefore agreeing in all reſpects will very rarely be met with.

Sometimes the bone is broken in one place only, the integuments ſimply divided, and very little lacerated or bruiſed, as when produced by a blow with a ſharp inſtrument. Sometimes the bone is broken nearly tranſverſely; at other times more oblique. In the leg, or fore arm, if one bone only is fractured, the other will ſupport the limb nearly in its proper form: I have ſeen a compound fracture of the tibia, in which the fibula kept the parts of the broken bone ſo perfectly in their ſituation, that the patient walked half a mile or more after the accident. Sometimes the ſoft parts are but ſlightly bruiſed, and conſiderably lacerated. Sometimes the laceration is inconſiderable, but they are violently bruiſed: this I have obſerved to be the caſe when a compound fracture is produced by violence applied to a bone ſuperficially ſeated; the integuments immediately covering the part were ſo bruiſed, that they died and ſloughed away. Frequently the bone, or bones, are broken in different places. Sometimes the bone is much ſhattered, and the ſoft parts violently cruſhed, to a conſiderable extent. Often the fracture extends through a joint; and ſometimes it is attended with an hæmorrhage from ſome conſiderable artery.

It is very ſeldom that a part ſuffers ſo much violence, as to be killed inſtantly. In the worſt caſes of compound fractures, the parts are generally left alive: but ſometimes the violence which the ſoft parts ſuffer is ſo great that, although it may not deſtroy their living powers, it ſeems conſiderably to leſſen them; at the ſame time, it ſtimulates them to an inflamed action ſo violent that they are unable to ſupport it, and mortification enſues.

The impoſſibility then of laying down rules, to regulate the peculiar treatment proper in particular caſes of compound fracture, muſt be evident. The obſervations on this head muſt, in great meaſure, be general: the treatment of each particular caſe muſt be regulated according to its circumſtances, by the judgment of the ſurgeon.

SECTION I.

OF COMPOUND FRACTURES REQUIRING IMMEDIATE AMPUTATION.

WHERE the whole of the ſoft parts ſurrounding one of the large bones are ſo much cruſhed, and torn, that their organization is nearly or wholly deſtroyed, while the bone is very much ſhattered through a conſiderable extent, there can be little doubt what ought to be done; amputation being the only means that can give the patient a chance for his life. For the limb in this caſe will certainly be loſt; and the violent inflammation, and extenſive mortification which will enſue, if it is not removed, will more endanger life than the ſhock from amputation, and the ſubſequent inflammation in the ſtump. But the loſs of a limb is not the only objection there is to amputation. When the patient is in full health, the whole ſyſtem receives a ſhock which excites an amazing irritation, both in body and mind, under which it frequently ſinks in a ſhort time.

Amputation is not, properly ſpeaking, a cure for compound fractures, but an apparently leſſer evil, intended to remove an apparently greater one. The amputation of a limb is always attended with ſome danger, and when performed on perſons who prior to the accident were in perfect health, as generally is the caſe in recent compound fractures, the danger attending it is very conſiderable. Therefore although I had no hopes of ſaving a limb, I would not amputate on that account merely, but wait till the violence of the inflammation is over; when the actions of life being weakened, and the mind of the patient prepared, he ſtands a better chance of ſurviving the operation.

In amputation, the degree of danger to the life of the patient varies according to the ſize of the part which is removed, and according to the extent of the wounded ſurface formed by the ſtump. The removal of the upper extremity is attended with leſs danger than the removal of the lower. Amputation above the knee is attended with conſiderable danger; immediately below it with ſomewhat leſs. I have ſeen patients loſt under both. When performed below the calf of the leg, the danger ſeems to be ſtill leſs. Thoſe amputations of the upper arm which have come to my knowledge have done well; though there has ſometimes been conſiderable irritation and fever attending them. As far as my obſervation extends, amputation below the knee, or below the ſhoulder-joint, is not attended with any conſiderable danger to life, unleſs in very unfavorable ſubjects.

When the patient is ſo ſituated that every neceſſary attention can be paid to him, the only inſtances in which I conceive immediate amputation to be neceſſary are

In ſome caſes of profuſe hæmorrhage;

And where the inflammation is likely to be extremely violent, and very extenſive; in conſequence of an extenſive laceration, and deſtruction of parts.

The diviſion ſimply of a large artery, even of the principal artery of a limb, as of the brachial for inſtance, or of the femoral below the two vaſti and the profundus, is not a ſufficient reaſon for amputation; as we may expoſe it by diſſection, and paſs a ligature round both ends of it. Experience proves that the anaſtamoſis is ſufficiently free to ſupply the limb with blood.

But ſometimes when there is an extenſive laceration of the ſoft parts, and a large artery deeply ſeated is divided, the inflammation enſuing the wound which muſt be made by the operation of paſſing the ligatures, added to the inflammation enſuing the accident, is too much for any conſtitution to bear.

Sometimes alſo, where there is an extenſive laceration of the ſoft parts, ſeveral pretty large arterial branches are divided, which, on expoſure to cold contract and ceaſe to bleed, on their becoming warm the hæmorrhage breaks out afreſh, but as ſoon as the ſurface of the wound is expoſed the bleeding veſſels again contract; by this means very often eluding our ſearch; or after one veſſel is ſtopped another breaks out. The hæmorrhage now and then continuing in this manner is ſo profuſe in a ſhort time, that the patient is very much ſunk from loſs of blood. Patients in theſe caſes require very cloſe attention; and if repeated endeavors to diſcover and ſecure the veſſel ſhould fail, the operation ought not to be delayed too long; for ſometimes, in a few hours, the inflammation and conſequent fever becomes ſo great, that if amputation is performed then it almoſt infallibly deſtroys the patient.

When the laceration and deſtruction of parts is very extenſive, or extending into a large joint, amputation is generally proper: as in ſome caſes we can remove an extenſive wounded ſurface, on which ſuch a violent inflammation would ſucceed that the ſyſtem cannot poſſibly ſupport it, and ſubſtitute in its place a ſmaller ſurface of wound, and a leſs violent and leſs extenſive inflammation, which there may be a chance of the ſyſtem ſupporting. There is ſo much difference in the ſtrength and irritability of different people, that it is impoſſible to ſay, à priori, without ſome uncertainty,

tainty, what degree or quantity of inflammation any particular perſon can ſupport, or even what degree or quantity of inflammation will actually come on. Very bad compound fractures, paſſing through joints, and expoſing an extenſive ſurface of wound, have in ſome caſes done well; while in other caſes, which ſeemed trifling compared with the former, the patients have ſunk: nay many ſink under amputation which is propoſed here as a palliative. In general, thoſe people who are given to exceſſes are the moſt unfavorable. Next, thoſe who are remarkably ſtrong and robuſt, of the athletic or ſanguine temperament. While thoſe who live temperate, are leſs robuſt, and approach to that ſtate of conſtitution called the phlegmatic temperament, are ſubjects of a more favorable prognoſis.

Generally ſpeaking, it ſeems to be the beſt practice to amputate,

1. In caſes where a compound fracture extends through a large joint if either bone is ſhattered; if both bones are fractured; or if the ligaments, and ſurrounding parts are ſo bruiſed, or lacerated, as not to afford a tolerable proſpect of its healing by adheſive inflammation. Thus if the extremities of the tibia and femur are both cruſhed, there is very little likelihood of the limb being reſtored; ſuch a violent inflammation would enſue as, it is moſt probable, would deſtroy the patient; and he ſtands a better chance for his life if the limb be amputated. But if the fracture paſſes through the extremity of one bone only, which at the ſame time is not cruſhed, nor the ſurrounding parts much bruiſed nor extenſively torn, there is a great chance of the ſoft parts healing by adheſive inflammation. If this ſhould fail, the means employed in attempting it tend to retard the inflammation; and with proper attention

the patient's life ſtands, in my opinion, as good a chance as after amputation. When the firſt ſymptoms are abated, there is a great probability of a cure by granulations; and ſhould the formation of pus become ſo exceſſive as to endanger life, amputation may then be performed with a much better chance of ſucceſs.

In the elbow-joint, the ſurface being much leſs than in the former, there is not that danger to the ſyſtem from inflammation extending over it; hence it will bear a much greater injury without rendering immediate amputation neceſſary. But if the bones are much cruſhed, as is often the caſe, from a loaded waggon paſſing over the arm, or from an heavy body falling on it when it is reſiſted on the other ſide; as there is little chance of rendering the limb uſeful, and as the ſubſequent inflammation would expoſe the patient to much greater danger than amputation would, it is the ſafeſt practice to amputate immediately.

In the ankle-joint the quantity of ſurface is leſs than in the knee, and greater than in the elbow. It is ſurrounded by a number of tendons: theſe when inflamed induce conſiderable conſtitutional ſympathy, and their living powers being but weak, they do not granulate very favorably. When this joint is ſo cruſhed as to produce a compound fracture, the ſurrounding parts will generally be bruiſed and torn to a great degree; and then the ſafeſt practice is to amputate immediately.

In compound fractures extending into the joints of the tarſus, or carpus, or any of the ſmaller joints, unleſs ſeveral of them were involved in the accident and there appeared no poſſibility of ſaving the part, I ſhould not amputate immediately.

2. In caſes alſo where the bone is ſhattered to a conſiderable extent; eſpecially if,

as is then generally the caſe, the ſoft parts are much cruſhed and lacerated. For in all probability ſo extenſive an inflammation, and perhaps mortification, will enſue, that the ſyſtem cannot ſupport it.

3. In ſome caſes alſo, where the miſchief to the bone and ſoft parts is not quite ſo great as in thoſe above-mentioned, if a principal artery of the limb be divided. For though neither the diviſion of the veſſel, the laceration, nor the fracture may ſingly juſtify the removal of the limb, yet the whole together will frequently render it neceſſary.

In a compound fracture of the thigh, with a diviſion of the femoral artery, provided the patient be not loſt from the hæmorrhage before aſſiſtance is obtained, it would generally be a raſh practice to attempt the ſaving of the limb. For the laceration of a very conſiderable portion of ſoft parts muſt take place, to produce a compound fracture and divide the artery at this part. The diſſecting down ſuch a depth, as is neceſſary in order to expoſe the artery and apply ligatures round both ends of it, will very much increaſe the ſurface of the wound and the conſequent inflammation: ſo many of the anaſtamoſing branches will be divided as greatly to leſſen the chance of the limb being ſupplied with the neceſſary quantity of blood; and the whole will give ſuch a ſhock to the ſyſtem, that it will be a miracle if the patient ſurvives.

In compound fractures of the upper arm with a diviſion or rupture of the brachial artery, if the parts are conſiderably torn, or cruſhed, it is ſafer to amputate: but when the bone is broken in one place only, and but a ſmall portion of the ſoft parts are lacerated, we may attempt to ſave the limb. The artery, as it extends along the inner edge of the biceps muſcle, is eaſily come at; and the ſurface of wound neceſſarily made for the application of the ligatures, is by no means conſiderable. There are two or three large branches given off from the brachial artery, juſt below the inſertion of the teres major muſcle, which communicate with others given off from the ſame artery, about the ſhoulder and elbow joints, and alſo with branches from the ulnar and radial arteries; ſo that the communication of veſſels ſeems much freer in the arm than in the thigh, while the parts to be ſupplied with blood are much ſmaller.

A compound fracture of the tibia with a diviſion of the poſterior tibial artery, will generally be attended with the loſs of the limb. The danger is not from the want of a free circulation below it; but being covered through the greater part of its length by the gaſtrocnemii muſcles, it is ſo deeply ſeated that it is almoſt impoſſible to get at it to make ligatures on it. Should the ſurgeon ſucceed, the length of the operation, and the extent of the wound muſt be ſuch, as, together with the fracture, much more to endanger the life of the patient than amputation would; nay, in all probability, to deſtroy him. But if this veſſel be ruptured below the gaſtrocnemii muſcles as it paſſes towards the inner ankle, it may be come at without any great difficulty; ſo that it is unneceſſary to amputate merely on account of the hæmorrhage.

If the anterior tibial artery be divided any where beyond the diſtance of about an inch from its origin, the difficulty or danger that attends making a ligature on it is but trifling, and ought to have very little weight in determining for amputation.

A diviſion or rupture of the interoſſeal artery is a diſagreeable circumſtance. For although it is ſmaller than either of the former, the hæmorrhage from it is likely to be very troubleſome. It is very deeply ſeated, and from its ſmallneſs difficult to find; and will I am apprehenſive often render amputation neceſſary: though I have ſeen it very ſmall in ſome ſubjects; and in that caſe, if the diviſion be pretty low down and quite through, it would moſt probably ſtop ſpontaneouſly. I have ſeen ſome caſes of compound fracture in which the hæmorrhage was not profuſe, and in a little time ceaſed; and upon the limb becoming warm, or in conſequence of one of thoſe convulſive motions which ſo frequently attend this kind of accidents, the hæmorrhage returned; on the limb being expoſed, it ſtopped again; and in the courſe of that or the ſucceeding day again returned. This continued for ten days, or a fortnight; when the patient was ſo reduced, that amputation became neceſſary to ſave life. By the apparent ſeat of the veſſel from which the hæmorrhage enſued, I was led more than once to think that it was the interoſſeal artery which had been wounded.

In the fore-arm the ulnar artery, in paſſing under the flexor ſecundi internodii pollicis, is ſituated pretty deeply; but below this, ſhould it be divided, it may be come at with little difficulty.

The radial artery is ſuperficially ſituated throughout its whole length.

In making ligatures upon either of the laſt-named arteries towards the wriſt, care ſhould be taken not to include any of the ſurrounding tendons. If this caution be neglected, a conſiderable inflammation is unneceſſarily induced, which greatly adds to the patient's danger.

There are, generally, two conſiderable branches of arteries called interoſſeal, which at the upper part of the fore-arm are very deeply ſeated. Theſe if lacerated are difficult to find; and if the hæmorrhage continued ſo profuſe as to reduce the patient to a ſtate of danger, might render amputation neceſſary. But the arm becoming ſmaller as they advance lower down, they are ſituated nearer the ſurface. Here an attempt may, and ought to be made, to paſs ligatures on them, unleſs other circumſtances indicate amputation.

4. Compound fractures ſometimes occur in which the violence done to the parts is far from being conſiderable, that are attended with an hæmorrhage, which has nearly ceaſed by the time the ſurgeon is called in. When the limb is dreſſed and becomes warm it breaks out afreſh; but on expoſing the wound to the air, it again ceaſes; and on its being dreſſed up, again breaks out; thus eluding every method that is taken to ſtop it, or to diſcover the wounded veſſels.

Caſes of this deſcription are extremely unpleaſant, and require the utmoſt attention. Sometimes a moderate preſſure being made on the part where the bleeding veſſel is ſuppoſed to lie, may anſwer the end. Sometimes a gentle preſſure round the limb is more effectual: but this mode requires great care; and when the inflammation comes on, the patient is ſeldom able to bear it. The application of ſpirits of wine, or what is a ſtill more powerful ſtyptic, ſpirits of turpentine, may be tried; but the latter muſt be uſed with caution, as it increaſes the inflammation. If the hæmorrhage is profuſe, care muſt be taken not to delay amputation too long; for if it be not performed before the inflammation comes on and the ſymptoms of irritation take place, there is little chance of its ſaving life. I have ſeen a patient ſink under the hæmorrhage in this caſe.

Some caſes of ſimple fractures of the tibia are upon record, where a ſlow but continued hæmorrhage produced ſuch an amazing diſtention of the limb, that it was thought proper to amputate. It was found on diſſection, that the bone was fractured juſt at the entrance of the medullary artery, which by conſequence was torn through, and from the firmneſs of its adheſion with the ſurrounding parts was incapable of contracting. Should a ſimilar accident occur in a compound fracture of this bone, and the ſurgeon be aware of it, there can be no great difficulty in ſtopping the hæmorrhage. A ſmall inſtrument paſſed into the hole will ſeperate the veſſel ſufficiently to allow of its contracting; and if the hemorrhage ſtill continues, its ſides may be preſſed together by a ſmall plug.

SECTION II.

OF UNION BY ADHESIVE INFLAMMATION.

Supposing that none of thoſe circumſtances occur which render immediate amputation neceſſary; our object is, if poſſible, to ſave the limb, and to reſtore it to its former ſtate and functions. To effect this object, the general indication ſeems to be,

To procure a re-union of the divided parts with as little inflammation, with as little deformity, and as ſpeedily as poſſible.

I have obſerved that there are two modes by which union takes place in compound fractures. Of theſe, that by adheſive inflammation is undoubtedly beſt adapted, in every poſſible reſpect, to the above indication: and could we always be ſo fortunate as to ſucceed in conducting the living actions of the part to this mode of cure, it would be unneceſſary to mention any other. Inſtances of union by adheſive inflammation in compound fractures are very rare; ſo rare that the generality of ſurgeons hardly ever think of attempting to procure it. Indeed it appears to me to be too much neglected. By attempting oftener, I am of opinion that much of the danger, pain, and confinement which generally attend compound fractures, may ſometimes be avoided. And even ſhould it fail, as it will more or leſs in many inſtances, the treatment which ought to be followed in attempting it is that which is moſt proper to leſſen the ſubſequent inflammation, to prevent an exceſſive diſcharge of of pus, and to forward the cure by granulations.

I have obſerved that in compound fractures the injury done to a part is very ſeldom ſo great as to cut off the circulation, or immediately to kill it; that mortification, when it occurs, is generally the conſequence of violent inflammation. If this obſervation be true, then by leſſening the inflammation, we leſſen, or even entirely prevent the mortification. The danger then of mortification taking place from exceſſive inflammation, does not prevent the attempting of this mode of cure. For the moſt certain way of preventing the increaſe of the inflammation is, to procure an union between the divided ſurfaces. Where there is a loſs of ſubſtance, and ſo great too that the parts cannot all be brought into contact, attempts may be made to procure adheſive union between the parts contiguous to the bone, to bring that, if poſſible, into the ſtate of a ſimple fracture. Should we fail in the attempt, ſtill it is proper to procure adheſive union as far as poſſible, by bringing as much of the ſurface of the wound into cloſe contact as the ſituation of the parts will permit.

In every caſe of compound fracture therefore, I would endeavor to unite the whole of the wound, or as much of it as is poſſible, by adheſive inflammation.

In order to render this mode of treatment as certain, and as effectual as poſſible, the following appear to be the principal indications.

1. To ſtop the hæmorrhage.

2. To reduce the bones to their proper ſituation.

3. To bring every part of the wounded ſurface into cloſe contact with its oppoſite ſurface.

4. To retain both the bones and ſoft parts in their proper ſituation, till they are united.

5. To moderate the violence of the inflammation.

§ 1. The firſt thing that commands our attention, in compound fractures, is the hæmorrhage. If profuſe, a tourniquet ſhould be applied, till the ruptured veſſel can be ſecured. In the preſent caſe, particular attention is requiſite, that the hæmorrhage does not continue, nor return after the parts have been brought together; otherwiſe the blood collecting and coagulating in the wound, will ſeperate its ſides, and fruſtrate our intention. This is a cauſe which very frequently prevents adheſive union taking place; therefore it cannot be too much attended to. Any veſſel that may be obſerved, from which we fear an hæmorrhage returning on the parts becoming warm, ſhould be ſecured by a ligature. This ligature ſhould include no more of the ſurrounding parts, than cannot poſſibly be avoided. The ſmaller veſſels will be prevented bleeding, by bringing the ſurface of the wound together: if this is not ſufficient, a very gentle preſſure may be made, but with great caution, by the bandage.

§ 11. The patient being placed upon a bed, and a proper ſupport (of which I ſhall ſpeak hereafter) being provided for the limb, the extremities of the broken bone ſhould be placed as nearly as poſſible in their natural ſituation. What other practitioners may have met with, I cannot ſay; but in thoſe caſes which I have met with, very little difficulty has occurred in this part of the operation. I have ſeen the ſuperior portion of a fractured tibia protrude ſo much, that it was propoſed to remove a conſiderable portion of it; but on relaxing pretty equally the muſcles of the limb, it was reduced to its proper ſituation with great eaſe. The limb then ſhould be placed in ſuch a ſtate, that all its muſcles may be relaxed as much as poſſible. The inferior portion ſhould be extended, when extenſion is found neceſſary, in a very ſlow, gradual manner; and then reduced to its natural ſituation. If, from the ſmallneſs of the external part of the orifice, the ſkin ſhould bind the bone too tight to admit of its being freely reduced; on examining the ſkin round the edge a part will generally be found which is rather hollow, from the ſoft parts beneath being lacerated beyond it; by dividing this the ſize of the opening may be ſufficiently increaſed. I very much doubt if ever it is neceſſary to remove a portion of the bone, in order to effect its reduction; but when the bone is protruded, if the fracture is very oblique, and a portion near the extremity is ſo denuded that it is more than probable an exfoliation muſt enſue, it is better, if it can be done conveniently, to remove that portion. In doing it, the greateſt care is neceſſary to keep the bone well ſupported, that it may not be jarred by the ſaw; and that no violence be done to the limb. If there be any ſpiculæ at the ends of the bone which are likely to prick or irritate the ſoft parts, theſe may be removed with a pair of forceps.

The bone being reduced, examination ſhould be made with a finger, if it can be introduced without violence, whether there can be any looſe portions of bone ſo far detached as to render it probable that the circulation through them is cut off; for ſuch portions when they can be come at ought to be removed. Otherwiſe, if they die, a conſtant irritation is kept up, and a troubleſome abſceſs formed by the preſence of an extraneous body.

§ 111. Having reduced the bones to their natural ſituation, the next indication is to bring, if poſſible, all the wounded ſurface of the ſoft parts, into contact. What! bring the ſides of a lacerated wound into contact with an intention of uniting them, before the ſloughs have ſeperated, or before the inflammation is reduced by a plentiful ſuppuration? Even ſo. We know that bad, lacerated wounds, even when connected with a fracture, do occaſionally heal, if they are ſo ſituated that the parts happen to fall in contact ſpontaneouſly. The caſe which happened to Mr. Pott himſelf, is a ſufficient proof of this. The parts falling accidentally in contact, and uniting during the adheſive ſtage of the inflammation, was, in my humble opinion, the reaſon of this caſe proving ſo favorable, and not, as was ſuppoſed, the excluſion of air merely—that was a neceſſary conſequence. If adheſive inflammation ſometimes takes place unexpectedly, where torn parts are by accident brought into contact, why ſhould not we endeavor, in every caſe, to avail ourſelves of it?

The principal objections that I have heard againſt this practice are,

That the inflammation is frequently ſo violent as to endanger mortification; and that to abate it we ought to induce an early and a plentiful ſuppuration.

That ſome portion of the ſoft parts are generally ſo injured in their ſtructure as to be incapable of union, until a part of them has ſloughed off; and that the wound ought to be left open for it to ſeperate.

That there is danger of confining or locking up (as it is called) the matter.

To the firſt of theſe objections I beg leave to anſwer, that the beſt, and the moſt certain means to prevent the inflammation becoming too violent, is to procure an union between the ſides of the wound, in the firſt ſtage of it. If union takes place, the ſtimulus is removed, the inflammation ſubſides, and the parts reſume their healthy actions.

Attempting it does not prevent the uſe of remedies to abate the inflammation; on the contrary, it co-operates with them, and ought always to be accompanied by them: for if the inflamed action hurries on too rapidly, it gets paſt the adheſive inflammation, before union has taken place. It appears to me in the next place, that it is the miſtaking of an effect for a cauſe that leads to this manner of reaſoning; that it is not ſuppuration, but the cauſe of that ſuppuration—to wit, the reducing of the inflammation to a certain ſtandard, which prevents mortification taking place. For in thoſe caſes of compound fracture where immediate amputation is thought unneceſſary, it ſeems to ariſe generally in conſequence of the inflamed action being too violent for the parts to ſupport; and ſeldom from the powers of life being ſo leſſened that they cannot ſupport a moderate inflammation.

Now ſuppuration cannot take place when the inflammation is ſo violent as to kill the parts. Conſequently, if we can induce ſuppuration; or, more properly ſpeaking, if we can keep down the inflammation to that point at which ſuppuration is produced, we effect a very deſirable object. By the ſame reaſoning, if we can induce union by adheſive inflammation; in other words, if we can keep the inflammation down to that point at which union by coagulable lymph is produced, we effect an object ſtill more deſireable; neither mortification, nor ſuppuration can take place, and neither are neceſſary.

When the inflammation has gone paſt the adheſive ſtage, and ſuppuration is produced, the diſcharge of pus which comes on ſeems to moderate the inflammation. But it muſt be remembered, that before any advantage is derived from this diſcharge, ſuppuration has come on, and then the danger from mortification is generally over.

With reſpect to the ſecond objection; when the ſtructure of a part is ſo deſtroyed that the circulation through it is cut off, it loſes its life, conſequently becomes incapable of any action depending on life; then it is abſurd to think of uniting it with the ſurrounding parts: it becomes an extraneous body, and acting as a ſtimulus, excites an inflamed and ulcerative action in them, and makes room for its removal. But in caſes where ſome doubt is left whether the circulation is, or is not, ſo far cut off from a part that it muſt die, and it is not judged proper to remove it, the moſt certain way to prevent its death is to attempt the uniting of it by adheſive inflammation; and ſhould the attempt fail, no harm can enſue.

As to confining the matter, it ſhould be recollected that matter muſt firſt be formed. Therefore, if the adheſive union ſucceeds fully, there is no great danger of confining matter: if the union be partial, as ſoon as matter is found collecting, it ought to be let out by a free opening, made in that part which is moſt favorable for its free exit in future. By this means we often derive conſiderable advantage, even where the attempt partly fails; at the ſame time that the quantity of inflammation is leſſened.

Before the parts are brought together, the moſt minute attention ought to be paid to the removal of extraneous matter, coagulums, or any hæmorrhage by which coagulums may be formed; as theſe, by preventing the parts coming in contact, will fruſtrate our intention.

To retain the ſoft parts in contact, different means may be employed. Slips of adheſive plaiſter are beſt, when they anſwer the purpoſe; as they irritate leſs than any other method. They ſhould be of ſuch a length as to retain the parts without being in danger of ſlipping, but ſhould not extend too far round the limb; for if much ſwelling ſhould come on, they will be liable to act as ligatures, confining and irritating the part, and retarding the return of the venous blood. They ought, alſo, ſo to be applied that they may be removed, when neceſſary, without moving the limb. Theſe may very advantageouſly be aſſiſted by a relaxed poſition of the wounded part; alſo, by the application of a many-tailed bandage moderately tight, but not ſo tight as to give pain. The bandage, by its preſſure, not only ſupports the ſides of the wound, but brings the inferior parts of it into cloſer contact than they would otherwiſe be brought. At the ſame time great attention is requiſite not to apply it too tight; for then, by the irritation it produces, it will increaſe the inflammation, and thus probably fruſtrate its intention.

Sometimes the retraction of the divided parts is ſo forcible, and the depth of the wound ſo great, that the above means are not ſufficient to retain the ſides of it in contact. In theſe inſtances, I recommend the paſſing of one, or more ligatures. I do not recommend the uſe of ligatures, if the parts can be brought into contact, and retained ſo without them; for ſome inflammation is excited by paſſing them, and ſtill more by the unequal preſſure which they make. But where we have reaſon to hope for the advantage of adheſive union, and the parts cannot be retained in cloſe contact by other methods, this ſhould on no account be omitted; and it ſhould be aſſiſted as much as is poſſible, by the other means above mentioned.

In bringing the parts together, whatever means are uſed, a very nice attention ought to be paid, that every part of the ſurface of the wound be brought into contact with its correſponding part; for it is not ſufficient that the integuments merely are brought together. I have met with ſeveral deep-ſeated lacerated wounds, where a ſufficient attention not having been paid to this point the external part united readily; but the internal part did not unite, and a troubleſome abſceſs formed. This is a point of ſo much conſequence to the ſucceſs of the plan of treatment here adopted, that I think it cannot be too much dwelt upon.

§ IV. Having thus brought the parts in contact, and applied ſome ſoft, mild application, to prevent the edges of the wound being irritated by the bandage; the next conſideration is, how to retain the limb perfectly ſtill, and in its natural ſituation, till bony union is formed. For this purpoſe, various means have been recommended;

all of which may probably be referred to, Poſition: and the application of external means, to ſupport, and confine the limb; as bandages, ſplints, &c.

1. In placing the limb, there ſeems to be two objects of conſideration; the eaſe of the patient, and the relaxing of the muſcles.

The body of the patient ought, if poſſible, to be placed in that ſituation which is eaſieſt, in which all the muſcles are moſt relaxed, and where the ſurface of contact on which he reſts is broadeſt; for in that poſition he will be able to continue longeſt without moving, and will be leſs liable to move inadvertently. It can require no other argument to prove how neceſſary it is that the body ſhould be kept in one poſture during the cure, than to obſerve that it cannot admit of the leaſt motion without moving the limb in ſome degree. Therefore lying in an horizontal poſture, on the back, upon a mattreſs, with the head, but not the ſhoulders, a little raiſed, will generally be found the beſt poſition. If the ſhoulders be raiſed, even but a ſlight degree, the patient will be perpetually ſlipping towards the foot of the bed, which is always diſagreeable, and often very troubleſome. In fractures of the leg and thigh, it has lately become a very general practice in this kingdom, to lay the patient on his ſide, that the limb may be placed in a relaxed poſition. But in moſt caſes which I have ſeen, this poſition ſoon became tireſome; and neither the patient, nor the limb, continued long in the ſtate they were firſt placed in. The patient generally turns upon his back, with the knee almoſt ſtraitened; or elſe, the thigh being turned out, the adductor muſcles are ſo much extended that the knee is perpetually being raiſed from the pillow, which keeps the fractured ends of the bone continually in motion. So that in fractures of the leg, the weight of the knee, and upper part of the limb, is in great meaſure ſupported upon the lower extremity of the ſuperior portion of the fractured bone: this, by its preſſure on the ſoft parts is continually irritating them, and increaſing the inflammation in them. In fractures of the thigh, the weight of the leg will draw the knee downwards; the tenſe ſtate of the adductor muſcles will in many inſtances draw the fractured extremities of the bone inwards. Thus there is danger of the fracture uniting in an oblique direction. Or, when the upper portion of bone does not ſupport the lower, whether from their extremities not being in a line, or from the obliquity of the fracture, the end of the lower portion will be drawn over that of the upper, and then the limb will be ſhortened.

Many practitioners, in fractures of the leg and thigh, ſtill continue to lay the patients on their back, with the limb extended. And indeed I cannot ſay that I have obſerved thoſe ill effects, from this poſition, which are ſpoken of by thoſe who are advocates for the leg and thigh being laid in a bent poſition, on its ſide. I have ſeen caſes treated in both ways, where the patients have recovered with very little deformity; and I have ſeen caſes of fractured thighs treated in both ways, where the limb has been ſhortened. And when a thigh that is fractured low down is laid on its ſide, if great attention be not paid to keep the knee properly ſupported, the bones are very liable, as I before obſerved, to unite at an angle.

I muſt not, however, be miſunderſtood as favoring the extended poſition of the limb; there are, certainly, conſiderable inconveniences occaſionally attending it. A number of muſcles are kept conſtantly extended; and the limb is very apt to be ſhortened, by the ends of the bone being drawn over each other. In fractures of the tibia, I have ſeen the gaſtrocnemii muſcles draw the inferior portion of the bone ſo much backwards, that the extremity of the ſuperior portion has projected very conſiderably; and, exciting ulceration through the ſkin, has produced a ſort of compound fracture. This however is not a frequent occurrence.

In a fracture of the leg or thigh, have ſometimes obſerved, that if the patient is placed on his back, with the limb extended, it for ſome days feels uneaſy, and there is a tendency to draw it up; but if he is at firſt placed on his ſide, with the limb in a bent poſition, and it continues ſo for a few days until the inflammation is ſomewhat abated, and then he gets round upon his back, with the limb ſtrait, as is often the caſe, he ſeems much relieved, and the cure of the limb goes on as well as, or better than before: for as the inflammation abates, the muſcles are leſs liable to be ſtimulated to contraction by extending the limb; and after the limb has been confined ſome time, the loſs of motion leſſening the actions which are going on for the ſupport of it, the muſcles gradually become weaker and leſs ſuſceptible of contraction, and ſeem to loſe in ſome meaſure the habit of contracting.

But I do not recommend this practice. Becauſe in moſt caſes it is not neceſſary for the patient to lie on his ſide at all, nor to keep the limb at all in an extended poſition; and becauſe it is improper to move the limb during the cure.

When the ſituation of the wound does not prevent it, the patient in my humble opinion ought in general to be laid on his back;

and by raiſing the limb and properly ſupporting it the muſcles may be relaxed, as far as the flexion of the limb will admit of it. In fractures of the thigh, great care ſhould be taken to keep it equally ſupported through the whole of its length: alſo the knee and leg ſhould be properly ſupported, that the weight of them may not draw down the lower end of the femur; and in general it is better to keep the leg in an horizontal poſition, that the extenſor muſcles may not be too much ſtretched. In fractures of the tibia, the leg ſhould always be in an horizontal poſition; and ſome compreſſes ought to be put under the ſmall of the leg, to prevent it reſting too much upon the heel. The limb may be ſupported either upon thick pillows, or upon a frame, which is better, being leſs liable to ſlip or yield. For fractures of the leg, a frame invented by a Mr. Rae, and delineated in plate 73 of Mr. Bell's Surgery, ſeems very well adapted; more eſpecially if the wound be at the inferior part of the limb. But if ſuch a frame is uſed, the thigh ſhould be ſupported by a pillow or two. In placing the limb, after a compound fracture, attention muſt be paid to the ſituation of the wound; for that muſt, if poſſible, be ſo ſituated that it may be come at, whenever it is neceſſary, without moving the limb.

When a fracture extends through a joint, the limb ought to be placed in that poſition in which it is moſt likely to be uſeful, in caſe an anchyloſis ſhould form; as will generally be the caſe if it is ſaved. Thus, in a compound fracture extending into the knee-joint, if it is thought proper to attempt to ſave the limb, it ought to be placed in an extended poſition; for if an anchyloſis forms with it bent, the leg will ever after be uſeleſs. I remember one caſe of this kind, where the patient was deſirous of having the leg amputated, on account of the inconvenience he ſuffered from its being always in his way. But an anchyloſed leg, when ſtrait, is infinitely better than an artificial one.

In a compound fracture extending into the elbow-joint, the arm ſhould be bent to about a right angle; which is generally the moſt convenient poſition.

If from any particular reaſon the parts cannot be placed in this ſituation immediately after the accident, they ſhould gradually be reduced to it as ſoon as poſſible after the inflammation abates.

Now that I am ſpeaking on the ſubject of fractures extending through joints, I will beg leave to obſerve, that in caſe the ſoft parts unite by adheſive inflammation, there remains a poſſibility of ſtill preſerving the motion of the joint. For this purpoſe, after the inflammatory ſymptoms are gone off, and oſſific matter is forming between the portions of bone, attempts ſhould be made to bend and extend the joint a little, daily, taking care not to excite too much inflammation; and any inflammation that may ariſe, ſhould be ſuffered entirely to ſubſide before the limb is moved again.

2. Having placed the limb properly, the next thing to be conſidered is, how to keep it in that ſituation during the cure. For this purpoſe, bandages, ſplints, junks, &c. are generally uſed.

Of the two former there are great varieties; ſome of which anſwer their purpoſes tolerably well; others very indifferently. To point out their advantages, and diſadvantages, it will be proper to conſider their uſes, and what we are to expect from them.

To keep a fractured limb in its proper ſituation, the motion to be avoided may be conſidered under two heads:

That which alters the ſituation of the whole limb; and

That which alters the ſituation of the fractured portions of bone, with reſpect to each other.

Bandages, and ſplints, will have very little effect, in preventing the firſt ſpecies of motion: the prevention of it muſt depend on the limb and body having a firm ſupport; and upon the attention of the patient to keep both unmoved. All that can be expected then from bandages and ſplints, is to keep the different parts of the limb in a proper ſituation with reſpect to each other.

The bandage generally uſed in compound fractures, is what is called the many-tailed bandage: indeed any other kind of bandage with which I am acquainted is extremely improper, on account of the neceſſity there would be of moving the limb every time the wound is examined. The beſt material to make it of, is ſome very fine welch flannel; as this is more elaſtic than any other material we are acquainted with, it better admits of an equal preſſure being applied to the limb, and more readily yields to a moderate diſtention. The pieces, of which it is compoſed, may be faſtened together as is generally done, or they may be ſeperated for the convenience of removing ſome of them, when neceſſary: for the removal of the pieces ſingly, will diſturb the limb much leſs than the removal of the whole bandage at once. Great attention ought to be paid, to apply the bandage in ſuch a manner that it may preſs equally. It ſhould be applied ſufficiently tight to ſupport the parts, and gently to preſs them together; but not ſo tight as to obſtruct the circulation, or to give pain; for then it increaſes the inflammation, and does harm. The moment it is noticed that the tumefaction of the limb increaſes ſo much that the bandage gives pain, or interrupts the freedom of the circulation by its preſſure, it muſt be looſened.

What is principally to be expected from a bandage, is gently to preſs the wounded parts together, and ſupport them; by that means aſſiſting to keep them in contact. It alſo confines, to a certain degree, the broken ends of the bone, and prevents them from moving ſo freely as they otherwiſe would.

But a bandage alone is very inadequate to the ſupporting of the whole limb in its natural poſition: therefore, after applying the bandage, recourſe is had to ſplints, junks, and other contrivances.

Splints, when well conſtructed, appear to be the moſt proper to keep the limb ſteady. They ought to be of ſuch a length as to confine the joint at each end of the bone; and, if practicable, the whole of the limb below the fracture; to prevent as much as poſſible the action of any of the muſcles, or the leaſt motion of the limb.

I obſerve not without ſome concern, that notwithſtanding what has been ſaid on the ſubject of ſplints by different people, more eſpecially by a late reſpectable author, and notwithſtanding the teſtimony of general experience is againſt them, ſhort ſplints ſtill continue to be uſed, even in compound fractures, by many people whoſe practice is pretty extenſive. That people ſometimes do well under their uſe, is undoubted; and ſo may a perſon in a miliary fever, whoſe bowels are conſtipated, and whoſe ſkin is covered with a profuſe ſweat from the action of pulvis ſudorificus, a hot room, and thick blankets: but the recovery in this caſe is no proof of the propriety of the treatment. Short ſplints are improper, in every caſe of fracture; and particularly ſo in compound fractures: they are incapable of preventing the motion of the limb, or of confining the fractured bone in its proper ſituation; and by their preſſure they increaſe that inflammation which is already too violent, and which requires the utmoſt attention to moderate it.

As ſhort ſplints do harm by their preſſure exciting inflammation, ſo it is neceſſary to be particularly careful in applying long ſplints, that no preſſure be made on the fractured part: it will be of no ſervice towards confining the limb, and may do great miſchief by unneceſſarily increaſing the inflammation. It is a good practice to line the ſplints with fine wool: but I have ſometimes obſerved an improper manner of doing it; which is, to apply the wool thicker in the middle, eſpecially over the wound, and thinner at each end. The contrary practice to this ought to be followed; by which means the ſound part of the limb and the joints will have the preſſure more equally applied to them, while at the fractured parts the ſplints will be a greater diſtance aſunder, and conſequently the preſſure on them will be removed.

The ſplints may be made of different materials. Thoſe made of wood, if they fit the limb and are ſufficiently excavated about the part applied to the fracture, are certainly the beſt. Paper ſplints, being ſufficiently firm, would anſwer the purpoſe as well; but when there is a diſcharge from the wound, it is liable to be abſorbed by them: they then become ſoft, and ſmell very offenſive. Where the ſurface of the limb is pretty even, as in the thigh, ſtrips of wood faſtened together by leather or packthread, make very good ſplints: but in fractures of the leg, the ſurface of the limb being very uneven, there is leſs riſk of preſſure being applied improperly when ſplints made of whalebone are uſed, provided firm wooden ſplints that fit the limb cannot be procured. To the inequalities on the ſurface of the limb ſhould be adapted correſponding inequalities on the lining of the ſplints, remembering at the ſame time to leave the fractured parts as free from preſſure as poſſible. When the limb is laid on a ſplint, the lining ſhould be made to ſupport the limb equally in every part; otherwiſe the fractured extremities of the bone may be inclined downwards, and unite at an angle. But the upper ſplint, or ſplints, ſhould be ſo lined as to preſs very lightly on the fracture.

Some people who are prejudiced in favor of ſhort ſplints, finding them incapable of retaining the limb in its proper ſituation and often doing miſchief by their preſſure, have been led to aſſiſt them by applying junks over them; and others, obſerving that miſchief is ſometimes done by the improper preſſure of long ſplints, prefer junks even to them.

With reſpect to the former treatment, ſhort ſplints ought never to be uſed, whether junks are or are not applied. With reſpect to the latter, improper preſſure may generally be avoided by properly lining or padding the ſplints. So that junks on this account are very ſeldom neceſſary; and as they do not confine the limb ſo ſecurely as long ſplints do, I think there are few caſes in which they are ſo proper.

If from the reſtleſſneſs of the patient, or from convulſive actions of the muſcles, the means above laid down are not capable of keeping the limb in its proper ſituation, a perſon ſhould ſit conſtantly by the patient, to ſecure it until theſe unpleaſant ſymptoms have ceaſed.

§ v. The limb being ſecured in a proper ſituation, and in ſuch a manner that it may be examined when neceſſary without moving it, we are next to attend to the ſucceeding inflammation. This muſt be moderated by every means in our power: for a very moderate degree of inflammation is ſufficient to produce adheſive union; and if the inflammation ſhould be too great, this mode of cure will fail.

In the more favorable caſes, ſome ſedative or diſcutient application may be applied to the limb. A diluted ſolution of acetum lithargi, with a ſmall quantity of ſpir. vini added to it; or the ammonia muriata, are as good applications as any. The bandages may be kept conſtantly moiſt with one of theſe, or ſome ſimilar application; and the wound, to prevent its being irritated, may be covered with ſome mild ointment.

If after this the parts ſhould become very tumid and painful, the ſplints ſhould be removed and the bandage opened; and a perſon being placed to guard the limb from the leaſt motion, ſeveral leeches ſhould be applied as near the edges of the wound as the plaiſters will admit of: theſe ſhould be repeated in the courſe of twelve or twenty-four hours, if there is occaſion. Tepid vapour may then be applied by means of fomenting flannels, wrung out in warm water or a decoction of poppy-heads; but in doing this, care muſt be taken not to move the limb, nor to irritate the edges of the wound. If the inflammation ſtill continues to increaſe, a poultice may then be applied. It is a ſoft, relaxing application, and a good means of regulating the temperature of the part: it may alſo be made the vehicle of any ſedative application. The poultices ſhould be applied, and removed, without ſtirring the limb. For this reaſon they had better be applied with a ſpoon, and removed again with a ſpoon, or ſpatula; for if the limb be the leaſt moved, that motion will increaſe the inflammation more than the poultice can diminiſh it. When we have reaſon to think that a poultice, or leeches, may become neceſſary, it is a good practice to have two bandages applied under the limb, with a piece of oiled cloth between them, and two or three bits of rag laid over it. By this means the lower bandage will be kept clean for future uſe; the rags will be of ſervice to confine the poultice, and may be withdrawn one by one as they become dirty.

When a poultice is applied it is impoſſible that ſplints can be of much ſervice in ſecuring the limb; and here I think I have obſerved junks to have the advantage. But if they are not applied at the time the limb is reduced, it ought by no means to be moved to apply them afterwards. In either caſe the limb ought not to be left; but a

perſon

perſon ſhould conſtantly attend to watch it; who, that his attention may not be taken off from it, ſhould have hold of the joint next above the fracture. By a ſtrict attention to theſe circumſtances I can from experience ſay, that poultices may frequently be uſed with advantage in compound fractures.

It may perhaps be objected, that poultices induce ſuppuration, whereas ſuppuration is what we are here endeavoring to avoid.

It appears to me that poultices, by keeping the ſurface of the parts to which they are applied moderately warm and moiſt, act as relaxants to the ſuperficial veſſels; by which means their ſuſceptibility to action is diminiſhed. The ſame effect is produced in the deeper-ſeated veſſels, from their ſympathizing with the former. By thus relaxing the veſſels we render them leſs ſuſceptible of the inflamed action; and by that means leſſen the inflammation. The producing of ſuppuration is not merely the effect of relaxing the veſſels, but of certain laws of the animal economy. For when the inflammation is ſufficiently kept under, whether by poultices or by any other means, if the parts are alive and the ſurfaces in contact, they will unite before ſuppuration can take place; and when they have united, the ſtimulus which kept up the inflammation having ceaſed, the inflamed action will ceaſe alſo, and the natural actions return: whereas if the inflammation is not ſufficiently kept under, or if the living parts are not in contact, adheſive union cannot take place; the inflamed action goes through the adheſive inflammation, and altering the ſtructure of the ſurfaces, produces pus.

Poultices may be rendered more effectual by the addition of emollients, and ſedatives; but in the uſe of the latter, ſome diſcretion is neceſſary. Cold is perhaps the moſt pow-

erful

erful ſedative that can be applied in the form of a poultice; but I by no means approve of its application in compound fractures; for cold, at the ſame time that it leſſens the actions, leſſens the living powers of a part. But in compound fractures, while we attempt to leſſen the actions, we ought to uſe every means to increaſe the living powers; for in general they are leſſened by the violence of the injury, and ſometimes to ſuch a degree, that there is danger of mortification from that cauſe alone, and ſhould we leſſen them ſtill further, that danger muſt be increaſed: beſides, to produce a ſedative effect, the application of cold ſhould be continued for a conſiderable time. But poultices ſoon take on the temperature of the limb: therefore it would be neceſſary for them to be repeated frequently; and this is diſagreeable.

Poultices ſhould never be ſo large as to irritate by their weight; nor ſhould they be continued on the limb ſo long as to become ſtiff and dry. They ſhould, in general, be repeated about once in eight or twelve hours. In applying, and removing them, great care ſhould be taken not to irritate the limb, nor to remove any of the ſlips of plaiſter which are applied to keep the ſides of the wound in contact.

If there ſhould be conſiderable ſymptomatic fever, with a hot, dry ſkin, and a quick, full pulſe, blood ſhould be taken from the arm. But in general as the fever is in proportion to the inflammation in the limb, three or four ounces of blood obtained from that part, by means of leeches, will do more good than ſixteen ounces taken from the ſyſtem, and will weaken the patient much leſs.

The ſurface of the body may be relaxed, and the hardneſs of the pulſe leſſened, by ſmall doſes of ſome antimonial preparation. But vomiting ought to be avoided. If the bowels ſhould be too open, ſmall doſes of opium may be given with the antimony.

The bowels ſhould be kept laxative; but ſtrong purgatives are improper.

The pain and ſpaſm which are uſually felt, are beſt allayed by opium.

The diet ſhould be ſuch as is eaſy to digeſt, ſuch as affords but little nouriſhment in proportion to its bulk, and is perfectly free from any ſtimulating quality. It ſhould at firſt be wholly vegetable; even new milk, unleſs much diluted, ought to be avoided. The aceſcent fruits, as oranges, currants, apples, &c. are proper; but thoſe of a higher flavor, as pines, melons, and moſt preſerves, ought to be avoided; for they are hard to digeſt, and by their preſence in the ſtomach are apt to induce nauſea and ſickneſs, to prevent the digeſtion of food, and I have ſeen them produce conſiderable irritation in the ſyſtem.

Condiments ſhould be avoided.

The drink ſhould be weak, without the leaſt proportion of ſpirit. Therefore all wines, and malt liquors, are improper. In their ſtead, toaſt-and-water, barley-water, infuſion of balm, and of other mild grateful herbs, ſhould be ſubſtituted.

How long this plan ought to be perſevered in muſt be left to the ſurgeon to determine, who is to be regulated by the ſtrength of the patient, and the ſtate of the inflammation.

SECTION III.

OF UNION BY GRANULATIONS.

IF, from the violence of the inflammation, from the deſtruction of parts, or from whatever cauſe, adheſive union ſhall not take place, we muſt then endeavor to promote union by means of granulations. For this purpoſe the ſame indications ſhould be obſerved as are laid down in Sect. 1.; excepting that, when the adheſive inflammation is paſſed, it is not neceſſary to take ſuch pains to keep the ſoft parts in contact. The ligatures, if any have been applied, had better be removed. The means for reducing the inflammation ſhould be perſevered in, as aſſiduouſly as before: for although inflammation is neceſſary to ſuppuration, and ſuppuration is neceſſary for granulations to form, yet the leſs we have either of inflammation or ſuppuration the leſs will be the danger to the life of the patient, and the ſooner will a cure be obtained.

Sometimes the injury not being very great, or in conſequence of the propriety of the treatment, the inflammation will increaſe but ſlowly, and will be attended with no very conſiderable pain, ſpaſm, or ſymptomatic fever; and in ſix or ſeven days, as the ſuppuration becomes free, will begin to diminiſh; and after a certain time, no accident happening, granulations will form, and gradually fill up the wound.

In theſe favorable caſes very little is neceſſary to be done. Care ſhould be taken that the operations of the economy, ſo far as they tend to the reſtoration of the limb, are not interrupted; and they alone will be ſufficient to reſtore the parts to an healthy ſtate.

In theſe caſes, the leſs there is done locally, the better. Some have a great dread of every thing that is greaſy, and are very fond of cramming dry lint into the wound; and I have even heard it aſſerted that the wound will not do well under any other mode of dreſſing. Others are as fond of introducing digeſtives, as they call them; and ſuppoſe that ſuppuration cannot take place without thoſe ſtimulating applications. Theſe notions, however, I can from experience ſay, are the effect of prejudice; and are often productive of miſchief. It is more than probable that their advocates never tried any other means, nor ever recollected that the production of pus, and of granulation, is an operation of the living powers of the economy, and not of their applications.

In my humble opinion the dreſſings, during the inflammatory ſtage, ſhould be quite ſuperficial; ſuch as are ſoft, lie eaſy upon the part, and are void of any ſtimulating quality. A common poultice ſeems the beſt application; for moſt other dreſſings, by abſorbing the blood and coagulable lymph, become hard, and adhere firmly to the edges of the wound; when by their irritation they increaſe rather than diminiſh the inflammation.

After ſuppuration has commenced, and the tenſion has abated, the poultice ſhould be left off; and if there is not a depending opening for the pus to eſcape by as it is formed, a little dry lint, introduced very lightly into the cavity of the wound, will abſorb a part of the pus, and thus leſſen the danger of its eſcaping into the ſurrounding reticular membrane. For an application to cover the wound, a piece of lint, ſpread over with cerat. alb. is as good as any thing. When the fractured ends of the bone are expoſed, and any of their ſpiculæ are obſerved to irritate the ſoft parts, they may be covered with a bit of lint. When it is obſerved that the diſcharge from the bones is very fetid, and acrid, as is ſometimes the caſe, ſome dry lint applied to the bone as far as it is denuded, will abſorb the diſcharge, and thus prevent its irritating the ſurrounding parts, which it is otherwiſe apt to do. It is not uncommon to meet with ſurgeons who are very attentive to apply dry lint over the denuded portions of bone, in every caſe, and without having any reaſon to aſſign for it; as if the lint poſſeſſed ſome unknown ſpecific quality by which it operated on them. I ſhould not think it worth while diſturbing this innocent prejudice, if I had not obſerved that ſometimes ſo large a quantity is crammed in as by its bulk to preſs conſiderably on the ſurrounding parts, increaſing inflammation and interrupting the proceſs of healing; and that ſometimes it is continued even where granulations are forming from the bone, when if the diſcharge is inſufficient to moiſten the whole lint, it adheres ſo firmly to them as not to be ſeperable without violence, and frequently the ſurface of ſome of the granulations will be torn away with it.

But frequently caſes of compound fracture occur which are leſs fortunate than thoſe above deſcribed, and in which diſagreeable ſymptoms ariſe that often terminate the life of the patient. Theſe ſymptoms will vary in different people, from the difference in conſtitutions, and from the difference in the degree of violence the part has ſuffered.

There is always ſome pain, and ſome degree of ſymptomatic fever; though at times I have been ſurprized to find them both ſo ſlight. There is alſo a ſpaſmodic twitching of the muſcles, which is more or leſs in different caſes, and which, generally, if ſomebody does not attend the limb, puts the patient in conſtant terror, and even prevents his ſleeping, for fear he ſhould inadvertently move it: if he gets into an imperfect ſleep, one of theſe twitches coming on will cauſe him to awake with a ſudden ſtart, and a ſenſation as if he was falling from a precipice.

Sometimes there will come on, very ſoon after the injury, violent ſhooting and throbbing pain, the part becoming very tumid, and violently inflamed; the ſymptomatic fever increaſing rapidly; the pulſe full, hard, and quick; the ſkin hot and dry; the countenance florid; the tongue dry and furred; the urine pale, and in ſmall quantity; frequently pain in the head and redneſs of the tunica conjunctiva, and ſometimes coſtiveneſs.

Theſe ſymptoms, if they are not moderated by local and general bleeding, and the antiphlogiſtic plan before laid down, will, in about two, three, four, or five days, terminate in another ſet, which mark extreme debility and irritation.

The pain becomes leſs throbbing, but more of a hot burning kind; and this alſo gradually ceaſes; the part becomes covered with ſmall veſications; the tumefaction ſubſides; the redneſs gradually changes to a dark, livid color; and the part becomes flabby, and pits on preſſure, and loſes its ſenſibility. The fever alſo abates; the pulſe becomes, at firſt, natural, but ſoon very weak, frequent, and at laſt irregular. The patient was before very reſtleſs on account of the pain, he now becomes more reſtleſs, though he cannot tell why. An unuſual quickneſs, attended with a trembling, may be obſerved in all his actions; when ſpoken to, he anſwers as if in a hurry. To theſe ſucceed delirium, extreme debility, and death.

In ſome caſes which I have ſeen, where the injury was very great; and principally in people who had been very irregular livers, and ſubject to frequent intoxication; the parts have not become ſo tumid as in the former caſe. The patient complained of a pain rather hot and burning than throbbing; ſo that the dreſſings, after they had been on a little while, ſeemed to ſcald him, attended with violent ſhooting pains, and ſpaſms of the muſcles, and an extreme reſtleſſneſs almoſt from the time of the accident: the pulſe quicker than natural, but by no means ſo full as in the former caſe. Sometimes the reſtleſſneſs is ſo great, that if the patient is not reſtrained by force, he will tear off all the dreſſings, and even get out of bed. Generally in two or three days the parts ſurrounding the wound are evidently gangrenous, when the pain will ſomewhat abate, and the patient be rather more compoſed; ſometimes he gets a little ſleep, but it is very diſturbed, and he frequently awakes in a great fright and in a partial delirium; to this a complete delirium very ſoon ſucceeds. Generally the gangrene has continued ſpreading, the ſymptoms of debility and irritation, ſometimes the delirium have continued increaſing, until the patient was carried off. The living powers in theſe caſes being previouſly in a debilitated ſtate, ſeem incapable of going into thoſe actions which are neceſſary for the reſtoration of the limb, they ſink under it—they die almoſt without attempting it.

I have met with one or two caſes, in ſeeming favorable ſubjects, where the violence done to the limb was very great; amputation was not performed, and the portion of the limb below the fracture died without any living action taking place in it. The inflammation in the wounded living part came on ſlowly, with very little tenſion, and with leſs pain and reſtleſſneſs than in either of the former caſes. The ſymptomatic fever came on very gradually, and was by no means violent; yet they ſunk, apparently exhauſted.

In the former of theſe caſes it is hardly neceſſary to ſay, that the moſt powerful means ſhould be had recourſe to, without loſing a moment, to moderate the inflammation. Bleeding, both local and general, ſhould be employed freely, more eſpecially the former: fomentations with opium; and emollient poultices with acetum lithargi, and opium. The limb ſhould be kept perfectly ſtill, free from preſſure and all other cauſes of irritation. The body ſhould be kept quiet, and in as eaſy a poſture as poſſible; the mind free from irritation. The bowels ſhould be kept open by gentle ſaline purgatives: the ſkin relaxed by antimonials, ſaline ſubſtances, and fomenting the extremities which are not injured, or by immerſing them in tepid water. The air in the room ſhould be cool. The diet ſparing, and free from ſtimulus: and indeed all thoſe means which are called antiphlogiſtic ſhould be had recourſe to, and ſhould be continued until the inflammatory ſymptoms are removed.

But as ſoon as it is found that theſe ſymptoms are terminating in ſymptoms of irritation and debility, the plan of treatment ſhould be changed; for the principal indications then are,

To ſtrengthen the living powers of the ſyſtem; and

To remove its extreme irritability.

In the treatment after mortification has taken place, we ought, I am of opinion, to be regulated by the ſtate of the ſyſtem, and by the degree of inflammation in the ſurrounding parts. For notwithſtanding that mortification has taken place, if the inflammation ſurrounding it is violent, and the ſymptomatic fever great, the antiphlogiſtic plan ſhould ſtill be continued. I think I have ſeen miſchief done from want of an attention to this rule. It is not an uncommon practice, the moment gangrene is obſerved taking place, without attending to the ſtate of the ſurrounding parts, or of the ſyſtem, to apply ſtimulating medicines to the part, and to throw ſtimulants, and cordials, into the ſtomach. This I have ſeen done when a ſmall portion of the integuments only were mortified, while the ſurrounding parts were intenſely tumid and inflamed; the patient raging with pain, and laboring under a violent ſymptomatic fever. The termination, as might naturally be expected, was in death.

The reaſon for this mode of practice I ſuppoſe muſt be, the dread of increaſing that debility which is always attendant on mortification when the inflammation ceaſes. But it ſhould be remembered that, in theſe caſes, this method of treatment increaſes the inflammation; and the more the inflammation is increaſed the further will the mortification extend: beſides, the inflammation will debilitate the ſyſtem more than the means employed to reduce it.

As ſoon however as the tumefaction and pain in the part, and the ſymptomatic fever begin to abate, bark ſhould be given in as large doſes as the ſtomach will bear. Indeed, if the inflammation diffuſes itſelf with a tendency to eriſipelas, it may be given earlier, and may often advantageouſly be combined with opium. Neither of theſe remedies are ſo much to be dreaded in inflammation as ſome practitioners would lead us to ſuppoſe. Opium is often given with propriety to remove diſagreeable ſymptoms in every ſtage of inflammation. Bark ſeems to operate by increaſing the tone and living powers of the ſyſtem; but I have never been able to obſerve any ſtimulant property by which it increaſes its actions. If, as I am humbly of opinion, it has no ſtimulant property, why ſhould we be afraid to give it in thoſe caſes where we want to increaſe the living powers of the ſyſtem, at the ſame time that we want to leſſen the too violent action of a particular part? As the ſymptoms of debility and irritation come on, the bark and opium ſhould be given more frequently, if the ſtomach will bear them; the patient ſhould alſo be allowed as much wine as he can take, and as much of a light, mild nouriſhing diet as will lay on the ſtomach.

If under theſe means the inflammation abates, and the mortification ceaſes to ſpread, the ſymptoms of irritation will abate; the pulſe, tho' weak, will be ſlower, and more regular; the appetite for food will begin to mend, and the patient become more compoſed.

In caſes anſwering to the ſecond deſcription, ſymptoms of debility and irritation come on almoſt immediately after the accident. The indications here from the firſt are, To ſtrengthen the living powers of the ſyſtem; and To remove its extreme irritability. Therefore, as ſoon as we obſerve theſe ſymptoms coming on, we ſhould give the bark as frequently and in as large doſes as the ſtomach will bear. Opium ſhould be added to the bark, and its quantity increaſed as far as the patient can bear it. He ſhould alſo be allowed, as in the former caſe, as much wine as he can take: indeed the treatment neceſſary in both caſes is ſimilar, the ſymptoms are ſo much alike.

Patients, in either of theſe kinds of caſes, bear large quantities both of opium and of wine. I have ſeen a patient under a mortification after a compound fracture, take 12 drachms of bark, 240 drops of tr. opii, and three pints of wine, every twenty-four hours, for ſome days, and it produced ſcarce any viſible effect on the head. This ſtate of the diſeaſe ſo often proves fatal, and in ſo ſhort a time, that when it occurs we are not juſtified only, but compelled by our duty to fly to the moſt powerful remedies. Bark, wine, and opium are the beſt and moſt powerful remedies we are at preſent acquainted with. They ſhould be given in large doſes, and repeated frequently; their effects ſhould be cloſely watched, and the exhibition of them ſhould be puſhed as far as poſſible; otherwiſe the patient will not have that chance for his life to which he is entitled. The bowels ſhould be kept open by glyſters, or gentle purgatives. Every ſource of irritation ſhould be avoided.

The diet ought to be very light, free from irritation, and eaſy of digeſtion.

With reſpect to the applications to the limb, in this ſtage of the diſeaſe, but little I believe in moſt caſes ought to be expected from them: our principal attention ſhould always be directed to ſupport the living powers of the ſyſtem, and by that means to prevent the ſpreading of the mortification. If there is violent local inflammation, local applications ought to be employed to reduce it, whatever may be the ſtate of the ſyſtem. I can ſee no impropriety in applying leeches, and other local means to reduce the inflammation in the limb, while we are giving bark to ſupport the powers of the conſtitution.

If after the mortification has begun the inflammation is not violent, thoſe means ſeem beſt which are beſt calculated to allay the irritable action which is then generally preſent.

It is an almoſt univerſal practice in this ſtate of the diſeaſe to apply ſpir. terebinth. and other ſtimulants to the limb, to enable nature (as it is ſaid) to throw off the diſeaſed parts. But with all deference to the knowledge and experience of others, I think this is a very bad, nay in many inſtances a very dangerous practice. This kind of ſtimulants, as far as I have been able to obſerve, poſſeſſes a power ſimply of increaſing action. Here is a want of living powers, not a want of action; inſomuch, that a degree of inflammation, which in an healthy ſubject can produce no bad effect, will degenerate into a diſeaſed irritable action, and be too violent for the parts to ſupport. We ought, therefore, in my humble opinion, to avoid ſtimulants, and every cauſe of irritation; to keep the limb perfectly ſtill; and, by the application of gently aſtringent poultices, to endeavor in ſome meaſure to allay the irritation, and to keep the parts of their proper temperature. Every thing elſe muſt depend upon our increaſing the powers of the conſtitution in general. If the mortified parts are very offenſive, there can be no harm in ſcarifying them to let out the putrid fluid they contain; nor can there be any objection to the application of fragrant ſubſtances to the dead parts, or even to the dreſſings covering the limb, if it is the fancy of the ſurgeon, provided care is taken that they do not irritate the living parts.

If by the means above laid down the progreſs of the mortification ſhall be interrupted,

rupted, the irritable eriſipaletous inflammation will ceaſe to ſpread, and an healthy inflammation will be obſerved to take place round the margin of the dead parts, which will be followed by an ulceration, that begins at the ſurface and continues progreſſively until they are ſeperated.

If the parts mortified are not very extenſive, there may ſtill be a poſſibility of ſaving the limb. But ſometimes the mortification will extend thro' the whole limb, or ſo far that the loſs of it will be inevitable; a large portion of muſcular ſubſtance, or ſome of the large blood-veſſels, being deſtroyed; or the extent of the wound may be ſo great, that the patient is in danger of ſinking from the exceſſive diſcharge. But in all theſe caſes, the operation ſhould be deferred, if poſſible, until ſome time after the ſeperation has begun, that the irritation of the ſyſtem may be ſomewhat abated, and time be obtained to make ſome attempts to recruit the ſtrength. No rule, however, can be given, at what time the operation ſhould be performed, in particular caſes: it muſt be regulated by the peculiar circumſtances attending them.

Provided the inflammation is not ſo great as to cauſe a mortification; or provided a mortification has commenced, and, the conſtitution being enabled to ſupport it, the parts are ſeperated, and the limb is ſo far likely to be ſaved; the next thing to which our attention muſt be directed is,

To prevent too great a formation of pus.

The quantity of pus will be in proportion to the violence of the inflammation, and to the extent of the ſurface from which it is ſecreted.

I have already ſpoken of the method of moderating the inflammation.

The extent of ſurface may ariſe from the wound being at firſt very extenſive; or from the pus not having a free exit as it is formed, when by collecting it forms ſinuſes, abſceſſes, &c.

The method of leſſening the original ſurface, I have already noticed, when ſpeaking of the cure by adheſive inflammation.

When inflammation goes on very rapidly, the adheſive ſtage is ſo ſhort, that there is not time for coagulable lymph to be thrown into the ſurrounding reticular membrane; that conſequently is left open, and if the pus has not a free opening to eſcape by, it is very liable to inſinuate by its gravity into the reticular membrane, and along the courſe of the muſcles, exciting irritation and ulceration; thus forming other inflamed ſurfaces that produce pus. By this means ſinuſes and abſceſſes are formed in parts diſtant from the ſeat of the injury. In a compound fracture of the tibia, where the injury done to the ſoft parts was comparatively trifling, ſling, I have ſeen ſinuſes form which extended up to the knee, and down below the tranſverſe ligament of the ankle. The beſt mean to prevent this accident appears to me to be, to retard the inflammation in the firſt inſtance as much as poſſible. For when the inflammation is long in going through its adheſive ſtage, a larger quantity of coagulable lymph is thrown out; and altho' it may fail in uniting the whole, or even a part of the ſurface of the wound, yet there is a greater chance of filling up the interſtices of the ſurrounding reticular membrane, and by that means circumſcribing the cavity of the wound, as is the caſe in common abſceſſes. But if we have not ſucceeded in this, we ſhould let the wound be as depending as poſſible; or form a counter opening, if it can be done, that the matter may be diſcharged as faſt as it is formed.

Whenever ſinuſes, or abſceſſes form, they ought to be opened very early; by this mean we ſhall prevent their extending from the matter collecting in them.

At this time the ſymptomatic fever is gone off; the patient is generally much debilitated, and requires to be ſupported. Therefore, tonics, good air, cheerful company, a nouriſhing diet, and occaſionally a ſmall quantity of wine, or malt liquor, is neceſſary.

If notwithſtanding theſe means the quantity of diſcharge continues ſo great that the patient is viſibly ſinking under it, amputation is neceſſary to ſave life. But we ought not to be in too great an hurry to remove the limb. I have ſeen caſes where there were ſinuſes extending in different directions, attended with a great diſcharge, hectic fever, loſs of appetite, with ſymptoms of general irritation in the ſyſtem, and the patients appeared to be ſinking very faſt: yet, upon laying the ſinuſes open, and giving bark internally in pretty large doſes, an almoſt inſtantaneous change has taken place; the ſymptoms of irritation have abated, the appetite has returned, and the ſinuſes healed in a very ſhort time. In a caſe where there were ſinuſes extending from the anterior-ſuperior part of the tibia down to the foot, they were opened as far down as the tranſverſe ligament, and the pus being carefully preſſed out, the parts were brought into contact, when they completely united by adheſive inflammation. But when the parts are much changed in their ſtructure from the long continuance of the diſeaſe, ſo rapid a cure cannot be expected.

However, if after having done every thing that art can point out, the diſcharge ſtill continues great, with ſymptoms of irritation, and with ſtrength and appetite gradually diminiſhing, the operation ought not to be deferred too long; for the patient may become

come ſo reduced as not to be able to bear the ſhock conſequent upon it. If the patient is able to ſupport the operation, and labors under no other diſeaſe than what is ſymptomatic of the diſeaſe in the limb, we ſhall generally, in two or three days after the operation, obſerve a change for the better. The hectic fever will abate; the appetite begin to mend; the ſtrength will viſibly increaſe; and the ſleep, which before is imperfect and interrupted, will now become ſound and refreſhing.

Now and then the bone continues diſunited, in compound fractures, for a conſiderable time after the accident has happened; the diſcharge not very exceſſive, but thin, ichorous, and fetid; with one or more ſmall orifices leading externally; and attended with conſiderable irritation in the ſyſtem, which ſometimes gradually ſinks under the diſeaſe. This may occur in every diverſity of conſtitution; but I believe is moſt frequent in thoſe conſtitutions which are very irritable, or have a tendency to ſcrophula.

If the patient in theſe caſes is very much exhauſted, it is better in the firſt place to attempt the recruiting of his health and ſtrength. This may often be accompliſhed by the uſe of tonics, and by a change of air and diet.

The wound ſhould then be examined. When there are ſeveral openings leading to the fracture, they ſhould, if their ſituation admits of it, be laid into one. If there are any ſinuſes, they alſo ſhould be laid open: when that is impracticable, counter openings ſhould be made into them. The bones ſhould be carefully examined. Sometimes one or more looſe fragments are found, which were the cauſe of the irritation and conſequent diſeaſed action: but more frequently a piece of exfoliated bone being retained, prevents the proceſs of healing. Sometimes, in the very compact bones, when a conſiderable portion of the bone is killed, the proceſs of exfoliation is very ſlow, and the irritation produced in the ſyſtem by the ſurrounding inflammation is ſo great, that the patient gradually ſinks under it; and, as the powers of the ſyſtem leſſen, the proceſs of exfoliation goes on ſlower. But the moſt frequent cauſe of this ſtate of diſeaſe ſeems to be, a partial death (if I may be allowed the expreſſion) taking place in the bone, in conſequence of the circulation being ſtopped by its veſſels being torn through. Thus a large artery, the medullary artery for inſtance, being divided, the circulation is totally cut off through a part of the bone, and it immediately dies, and ſoon after the exfoliation of it begins. In another part of the bone, the circulation is not entirely cut off; it is ſufficient to ſupport life for ſome time. But the circulation and living powers being both very weak, a very ſlight cauſe puts a ſtop to them; ſo that the inflammation extending from the ſurrounding parts, or any other accidental cauſe, produces the death of the bone. As this ſometimes happens in different parts at different times, we now and then meet with tedious exfoliations taking place ſucceſſively.

If we find any fragments, or looſe exfoliated pieces, they ought to be removed. If there ſeems to be a large portion of bone exfoliating, and we think the operation and conſequent diſcharge not too great for the patient to ſuſtain, I think it better to trace the exfoliating bone through its extent, and by the application of the trephine, if it appears neceſſary, and of gentle ſtimulants, ſuch as tr. myrrh., ſpir. vin., &c., attempt to increaſe the action of the abſorbents in the living part to which it is in contact. When a portion of bone ſeems to poſſeſs ſuch weak living powers that in all probability it will die and exfoliate, the proceſs will be very much forwarded by cutting off the circulation and killing the part at once. Various means have been recommended for this purpoſe; but the beſt and ſafeſt way ſeems to be, to make a number of perforations, ſo as almoſt to ſeperate it from the more vigorous part.

After the ſinuſes have been opened, and the exfoliations have ceaſed, we ſhall generally find that a more healthy action will commence; that the parts will gradually aſſume their natural appearance, and the diſcharge become good pus. The health at the ſame time will mend; the granulations will aſſume an healthy appearance, and by degrees fill up the wound.

Sometimes however, notwithſtanding all that we can do to retard it, the patient's ſtrength continues declining, and the extent of the diſeaſed part is ſo great, that it is a ſafer practice to remove the limb than hazard his life by an operation the ſucceſs of which is ſo uncertain, and in a caſe where the actions of the economy are ſo ſlow that, if it ſhould exceed our moſt ſanguine expectations, yet it muſt be a long time before a cure can be effected.

Sometimes the inflammation in the bone becomes too great, and extends through its whole length, cauſing an increaſe of its bulk, and ſometimes an increaſed depoſit of oſſific matter, leſſening the tendency to granulate; and frequently attended with a very offenſive diſcharge, an obtuſe pain along the courſe of bone, with conſiderable irritation, debility, and emaciation of the ſyſtem. The progreſs of this bony inflammation is very ſlow; ſometimes, if the patient ſurvives, continuing for many years. In this caſe the weakneſs of the living powers in bone ſeems very evident. An inflamed action is brought on, which the powers of life are incapable of conducting to its natural termination. It has little tendency to diminiſh or reſolve, ſtill leſs to ſuppurate; and in general the bone poſſeſſes too much living power for it to terminate in death. It therefore continues nearly ſtationary; and the bony matter being generally depoſited faſter than the abſorbents remove it, the bone, as far as the inflammation extends, becomes remarkably increaſed in ſize, weight, and ſolidity. Now and then this bony inflammation extends to the reticular membrane, and even to the other ſurrounding parts, changing them into a bony ſubſtance.

Fortunately, however, the diſeaſed ſtate of the bone, of which we are now ſpeaking, very rarely occurs in conſequence of compound fractures.

In theſe tedious caſes, the limb below the fracture generally undergoes a conſiderable change. Being kept continually in a ſtate of reſt, the circulation becomes languid, and the muſcles not being ſupplied with a due proportion of nutriment generally leſſen in bulk, and ſometimes to a very great degree, and the limb is generally below its natural temperature. This ought to be no objection to our endeavoring to ſave the limb ; for if we ſucceed, on the part being again put in motion, the action of the muſcles will again increaſe the force of the circulation through them, and in time they will acquire their former ſize.

A caſe of compound fracture came under my care, a few days ſince, where the limb inſtead of becoming ſmaller had increaſed to an enormous ſize. It was a compound fracture of the humerus near to the inſertion of the deltoid muſcle, and had happened about eighteen months before. A conſiderable portion of each broken extremity of the bone had exfoliated, but not having been removed the proceſs of healing could not go on. A conſiderable quantity of coagulable lymph was thrown into the ſoft parts around the fracture; had almoſt deſtroyed their natural ſtructure, and had rendered them ſo firm that the bone ſeemed as if ſurrounded with cartilage. From the elbow downward the limb was amazingly but uniformly diſtended, with an elaſtic, ſlightly edematous feel.

On diſſection, the muſcles were found of a florid-red color; and they appeared to be full as large as thoſe of the other arm, if not larger. The cellular membrane covering them was of a great thickneſs, containing coagulable lymph and adeps principally, with a ſmall proportion of water.

FINIS.